ROHDE & SCHWARZ

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Instruction Book

U H F T E S T R E C E I V E R

Type USVD BN 1523

Note: Always quote the Type and Order Number (BN) in addition to the Serial Number (FNr.) of the set when asking for technical information and, in particular, when ordering repair parts.

ROHDE & SCHWARZ, MÜNCHEN

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1. Specifications

Principle	superheterodyne receiver with broadband input
Fundamental frequency range	280 to 940 mc
Frequency range in harmonic operation	up to 4600 mc
Frequency range of the oscillator	305 to 915 mc
Intermediate frequency	25 mc
Calibration of the frequency scale	
Fundamental frequency range ($f_{osc} - f_{if}$)	280 to 890 mc
Fundamental frequency range ($f_{osc} + f_{if}$)	330 to 940 mc
Range of the 3rd harmonic ($3\ f_{osc} + f_{if}$)	940 to 2750 mc
Range of the 5th harmonic ($5\ f_{osc} + f_{if}$)	1600 to 4600 mc
Noise figure in the fundamental frequency range	17 to 19 db at a voltage source with a source impedance of 50 to 75 Ω (corresponding to an input voltage of about 5 to 6 µv)
Sensitivity loss in harmonic operation	
with the 3rd harmonic	about 10 to 20 db
with the 5th harmonic	about 15 to 25 db
Measuring range	
in the fundamental frequency range	30 µv to 30 mv (60 db)
in harmonic operation	300 µv to 30 mv (40 db)
Voltage indication	by pointer type meter
Voltage calibration, relative	(a) attenuator: in decibels (b) meter: proportional to voltage
Attenuator steps	6 x 10 db 10 x 1 db 10 x 0.1 db

Accuracy when measuring voltage ratios with the attenuator

in the fundamental frequency range	± 1 % of the db value ± 0.1 db
in harmonic operation	about ± 5 % of the db value ± 0.1 db
Input	R&S connector Dezifix B +)
I-f bandwidth	2 mc
I-f output	R&S connector Dezifix B +), open-circuit voltage about 0.6 v_{rms}, output impedance 60 Ω
Demodulation	for AM

Output for the demodulated signal

I: Broadband, high impedance	13-mm socket, 100 cps to 200 kc, about 60 v_{pp} into more than 50 kΩ
II: Broadband, low impedance	13-mm socket, 20 cps to 1 mc, open-circuit voltage about 0.5 v_{pp}, output impedance 75 Ω
III: For head-phones	telephone jacks, 500 to 2000 cps, 0 to 2 v_{rms}, variable, into about 4 kΩ

The voltage values at the outputs correspond to full-scale deflection on the meter, those specified for the demodulated signal referring to 50 % modulation.

Power supply	115/125/220/235 v ± 10 %, 47 to 63 cps (165 va)
Valves, etc.	1 valve DL 41 1 valve EC 55 3 valves EF 40 6 valves EF 80 5 valves PL 81 2 reference tubes 85 A 1 1 miniature neon lamp 220 v 1 fuse 1 amp 1 pair of crystal diodes GK 1012 C
Dimensions	540 x 370 x 378 mm (R&S Standard Cabinet 510)
Weight	about 38 kg

+) This instrument can be equipped with different connectors if requested when ordering.

2. Uses

The UHF Test Receiver Type USVD is used mainly for accurate measurement of voltage ratios up to 60 db in the frequency range 280 to 940 mc. This frequency range is extended up to 4600 mc when the input signal is mixed with the third or fifth harmonic of the built-in local oscillator. In this case voltage ratios up to 40 db can be measured.

The Type USVD receiver can be used, for example, as an extremely sensitive indicator for slotted lines. It allows high voltage ratios up to 1 : 1000 to be measured as easily and accurately as low ones of the order of 1 : 1.01. Its high selectivity (i-f bandwidth 2 mc) is of special advantage if the signal generator feeding the slotted line delivers sufficient harmonics in addition to the fundamental. An error due to harmonics, such as might occur with an aperiodic indicator, is thus eliminated.

Owing to its high voltage sensitivity this receiver permits measuring the impedance of circuit elements which due to their voltage-dependent impedance can withstand only a relatively small test voltage. This holds, for example, for measurements on circuits with crystal diodes.

This test receiver also lends itself to accurate and simple measurements of the attenuation and frequency response of UHF attenuators or filters. It allows measurements which, in this frequency range, are not possible even with the best standard attenuators available nowadays.

An FM demodulator or frequency deviation meter can be connected to the i-f output, 25 mc, of the Type USVD. In conjunction with the R&S Frequency Deviation Meter Type FMV, 20 to 300 mc, the Test Receiver Type USVD permits satisfactory measurements of both the percentage modulation and incidental frequency modulation of an amplitude-modulated UHF generator.

Further applications are possible due to the low- and high-impedance broadband outputs for connection of an oscilloscope, and due to a narrow-band output for headsets. If the test receiver is used as the null detector of a bridge fed with a modulated voltage, r-f voltages of 1 µv can still be monitored satisfactorily, i.e. full benefit can be drawn from the accuracy of the bridge.

3. Description

3.1 General

The circuitry of the UHF Test Receiver Type USVD (see circuit diagram) essentially consists of the following stages:

(a) High-pass filter L1-C1-L2 for suppression of all input frequencies below 280 mc.

(b) Mixer, broadband, with crystal diodes G11-G12 and i-f transformer L7-L8 tuned to 25 mc.

(c) Local oscillator Rö1 and low-pass filter L14-L13-L12 for suppression of the harmonics of the oscillator.

(d) Three-dial attenuator with the steps 10 x 0.1 db, 10 x 1 db, and 6 x 10 db.

(e) Four-stage i-f amplifier Rö2-Rö3-Rö4-Rö5 with subsequent rectifier G13 and moving-coil meter I2 for indication of the r-f input voltage.

(f) I-f buffer stage Rö6; the i-f signal then passes through L37, attenuator R114-R115-R116, and cable K7 to the i-f output—25 mc, open-circuit voltage less than 0.6 v, output impedance 60 Ω.

(g) Full-wave rectifier G14-G15 for demodulation of the modulated i-f voltage, and a-f broadband amplifier Rö7. Cable K8 connects the broadband high-impedance a-f output—100 cps to 200 kc, output voltage 60 v into more than 50 kΩ—to the anode circuit of Rö7 while the narrow-band output for headphones—500 to 2000 cps, 0 to 2 v into more than 4 kΩ—is connected to this anode circuit, via the transformer Tr1 and volume control R176. The broadband low-impedance a-f output 20 cps to 1 mc—output voltage less than 0.5 v, output impedance 75 Ω—connects to the cathode of Rö7 through the voltage divider R123-R129 and cable K9.

(h) Electronically regulated power supply with power transformer Tr3, heater transformer Tr2, and the ten valves Rö8 to Rö11 and Rö13 thru Rö18. Rö15-Rö13-Rö14 serve to stabilize the anode voltage of the oscillator, Rö8-Rö9-Rö10-Rö11 to stabilize the anode voltage

of the i-f amplifier, and Rö16-Rö17-Rö18 to stabilize all filament voltages. Rö12 is in series, for direct current, with the oscillator valve Rö1 and functions as a current regulator valve. Its anode resistance can be adjusted with the control R189 so that the oscillator supplies the correct heterodyning voltage to the mixer stage, as shown by the deflection of the moving-coil ammeter I1 which indicates the rectified voltage of the mixer diodes G11-G12. This adjustment is of special importance for the accurate measurement of voltage ratios, since with too low a heterodyning voltage the limit (30 mv) of mixer linearity would be shifted to a lower point, whereas with too high a heterodyning voltage the noise of the mixer would increase and the lower limit, 30 µv, of the measurement range would be at a higher value. In both cases the measurement range of 60 db would be narrowed down.

3.2 Mixer, Oscillator, IF Amplifier

The oscillator covers the frequency range of 305 to 915 mc by non-contacting impedance variation and without switching. The input frequency f_{in} can be mixed with both the fundamental wave, 305 to 915 mc, and the 3rd or 5th harmonic, 915 to 2745 mc or 1525 to 4575 mc, of the oscillator frequency. The harmonics are generated in the mixer. Since no preselection is provided, each input signal appears twice. The drum dial scale is calibrated for the following input frequencies:

$$f_{in} = f_{osc} - f_{if} = 280 \text{ to } 890 \text{ mc}$$
$$f_{in} = f_{osc} + f_{if} = 330 \text{ to } 940 \text{ mc}$$
$$f_{in} = 3\, f_{osc} + f_{if} = 940 \text{ to } 2750 \text{ mc}$$
$$f_{in} = 5\, f_{osc} + f_{if} = 1600 \text{ to } 4600 \text{ mc}$$

A flywheel drive with a high gear ratio permits very sharp tuning and rapid coverage of the entire range. Since the local oscillator voltage is applied to the balanced mixer and the received signal arrives through a parallel arrangement, the reradiated oscillator voltage at the receiver input is very small. At input voltages up to 30 mv the mixer characteristic is linear, that is, a certain input voltage variation involves an accurately proportional variation of the generated i-f voltage. If the attenuator is set to zero at the low input voltage and if then, with the high input voltage applied, the attenuator is adjusted for the value

yielding the same deflection on the meter I2 as previously obtained at the low input voltage, the unknown voltage ratio can be read directly from the attenuator, 0 to 60 db, between the mixer and i-f amplifier. The meter calibration is relative. The switch S5 permits selecting a normal, 0 to 1, or expanded, 0.7 to 1, range. The expanded range is particularly advantageous in the measurement of very low voltage ratios (0 to 3 db) as it allows a direct and accurate reading of the ratio of E_{max} to E_{min} to be taken on the meter. To extend the range, part of the voltage stabilized in the power supply Rö8-Rö9-Rö10-Rö11 for the i-f amplifier is tapped from the voltage divider R136-R137-R138 and is used for biasing the rectifier G13. Thus the meter (G13-I2) functions with the zero suppressed. The resistor R136 has been so adjusted that the two ranges of indication exactly coincide, that is, at a certain input voltage only the deflection, not the reading, will change if the switch is thrown to the other position.

Switch S4 permits the coarse adjustment of the i-f gain in five steps and control R177 the fine adjustment. Thus the gain can be set so that the noise does not exceed the value admissible for accurate measurements (blue mark of I2). On the other hand, this permits a continuous fine adjustment of the receiver gain within a large range when the generator output voltage is not accurately adjustable. During the measurement of a voltage ratio the attenuators should be varied but the i-f amplification should not. To provide an i-f bandwidth of 2 mc, two of the five i-f circuits are stagger-tuned, that is, L27, L29, and L35 are centre-tuned to 25 mc, while L31 is tuned below and L33 above the mid-band frequency. Ease of tuning is ensured, even at the highest receiving frequencies, by the relatively large bandwidth and the backlash-free drive of the variable capacitor.

For other uses, the amplified i-f signal is passed to a coaxial output socket, R&S connector Dezifix B, through the buffer stage Rö6, i-f transformer L37, voltage divider R115-R116, and cable K7. The output impedance of this socket is 60 Ω, the open-circuit voltage about 0.6 v. This permits, for example, the connection of a frequency deviation meter for the measurement, say, of the incidental frequency modulation of an UHF transmitter. Owing to the buffer value Rö6 the i-f voltage at the meter rectifier G13 remains unaffected by the type and magnitude of the external load.

3.3 AF Section

The i-f signal is demodulated by the full-wave detector G14-G15 to allow aural monitoring or connection of an oscilloscope. The a-f signal passes via the low-pass filter L38-L39, which rejects the i-f, to Rö7 and into three different channels. Two channels connect to the anode of Rö7, one to the cathode. The highest voltage, which is sufficient, for example, for direct modulation of a cathode-ray tube, is available at the output connected to the anode through C68 and K8. At a modulation depth of 50 % and full-scale deflection of the i-f meter I2 a voltage of 60 v_{pp} is present at this output provided the external load, such as the input impedance of the oscilloscope, is at least 50 kΩ. The pass band of this output is 100 cps to 200 kc. About half the a-f voltage of this channel is tapped at the attenuator R125-R127 and applied, via the transformer Tr1 tuned to about 1000 cps, to the phones output adjustable by R176. The bandwidth of this output has been kept very small, 500 to 2000 cps, in order that the modulation tone may be clearly distinguished from the inevitable noise. For example, an r-f voltage of 1 µv, 100-% modulated at 1000 cps, can be detected satisfactorily. The greatest bandwidth of from 20 cps to 1 mc is obtained at the output which via cable K9 and decoupling section R123-R124 connects to the cathode of Rö7. This output has an impedance of 75 Ω and provides for a voltage of 0.5 v_{pp} at 50 % modulation and full-scale deflection of the meter I2.

3.4 Power Supply

It goes without saying that a test receiver measuring relative voltage ratios with an accuracy of ± 1 % requires extremely stable operating voltages, the requirement being for a very stable gain and oscillator frequency. The overall gain during a measurement must not change by more than about 0.1 %. Only under this condition is it possible to measure small voltage standing wave ratios, e.g. $E_{max}/E_{min} \leqq 1.1$, with high accuracy. In addition, the oscillator frequency should remain practically unchanged during the check on at least two points, E_{max} and E_{min}. This is particularly important at the higher receiving frequencies; at 4000 mc, for instance, a variation of the oscillator frequency by not more than 0.02 % = 800 kc would require retuning of the receiver. The design of an UHF oscillator, however, is very difficult if a high frequency stability is required, as this not only necessitates a high stability of the mechanical layout but also of the filament and anode voltages.

The stabilization of the operating voltages is much more important for a test receiver of this class than it is for other high-grade receivers where a gain variation of several per cent caused by a-c supply fluctuations plays an unimportant part only.

At the primary end, the power section has tappings for 115 v, 125 v, 220 v, and 235 v a-c and is protected by the fuse Si1. The small neon lamp Rl1 which is connected to the 220-v winding and is provided on the front panel over the power switch S6 serves to indicate the presence of a-c supply voltage. At the secondary side a separate power section each is provided for the oscillator Rö1 and the i-f and a-f amplifier Rö2 to Rö7.

The anode supply voltage of the oscillator is generated by the two rectifiers Gl8-Gl9, filtered by the LC section L57-C89, and stabilized by the three valves Rö15-Rö13-Rö14. Rö15 is the series regulator valve, Rö13 the control valve of Rö15, and Rö14 the reference valve. In contrast with the power section of the i-f and a-f amplifiers, the positive pole of the anode voltage source, i.e. the cathode of Rö15, is taken to earth. This is necessary because of the design of the oscillator where the anode of the valve is earthed for the d-c current. The negative pole of the anode voltage is connected via R152 to the cathode of the current regulator Rö12 and through the anode resistance of the latter to the cathode (filament) of the oscillator valve Rö1. The potentiometer R189 permits adjusting the anode supply voltage of Rö1 and thus varying the screen grid voltage of Rö12 and hence the anode resistance of this valve. This potentiometer, which also controls the heterodyning voltage produced in the oscillator and applied to the mixer, should be adjusted prior to a measurement so that the mixer diode current indicated on the moving-coil meter I1 has a given value identified by a scale mark.

The anode voltage of the i-f and a-f amplifiers is produced by the two rectifiers Gl6-Gl7, filtered by the LC section L56-C88 and stabilized by the four valves Rö8-Rö9-Rö10-Rö11. The circuitry of this power section largely corresponds to that of the oscillator. Here, however, two current regulator valves Rö8-Rö9 are connected in parallel because of the higher anode current requirement; the negative pole of the anode voltage is taken to earth. The stabilizing circuit functions as follows: If, for instance, the a-c supply voltage decreases, the load voltage between the cathode of Rö8-Rö9 and earth will also drop. Thus

the grid voltage taken from the voltage divider R142-R143-R144 and applied to the control valve Rö10 becomes more negative. This involves a decrease in anode current of Rö10 and thus a decrease of the voltage drop across the anode resistor R141, that is, the voltage at the anode of Rö10 becomes more positive. Thus the grid voltage at the current regulator valve also becomes less negative and its anode resistance is reduced to such a degree that the load voltage increases to its original value.

The circuitry serving to stabilize the filament voltage of the oscillator valve Rö1 and of Rö2 to Rö7 of the i-f and a-f amplifiers consists of the rectifiers Gl10-Gl11, the heater transformer Tr2, and the valves Rö16-Rö17-Rö18. The anode resistance of Rö16 lies between the centre tap 8 of the power transformer Tr3 and the centre tap 2 of the heater transformer Tr2. The filament voltage to be stabilized and the filament voltage of Rö18 are connected to 9-10, 7-8, and 11-12 at the secondary side of Tr2. The stabilizing circuitry functions as follows:

First let us assume that no lead is connected to the centre tap 2 of Tr2. Thus no current will pass through the primary winding 1-2-3 of Tr2 because of the blocking action of one of the rectifiers Gl10 or Gl11. If, however, a resistance (anode resistance of Rö16) is inserted between tap 8 of Tr3 and tap 2 of Tr2 the winding 1-2 and 3-2 passes alternately the current from Gl10 and Gl11, i.e. one half-wave flows through Gl10-1-2, the other through Gl11-3-2. These two half-waves unite at the secondary side and thus yield the sinusoidal heater voltage which, in turn, depends on the magnitude of the anode resistance of Rö16. The smaller the latter, the higher the current flowing through the primary winding 1-2-3, that is, the heater voltage is higher. This anode resistance is controlled by Rö17 and a bridge circuit whose arms are formed by the anode resistance of the Rö18 and the three resistors R169+R167, R168, and R170. The bridge is supplied with the anode supply voltage, 300 v, of the oscillator power supply.

If, for example, the a-c supply voltage increases the filament voltage of Rö18 also becomes greater and thus the anode resistance of this valve decreases. Thereby the bridge is thrown out of balance and causes the grid voltage of Rö17 to become less negative. Its anode current thus becomes greater as does the voltage drop across its anode resistor R165 so that the grid of Rö16 becomes more negative. Simultaneously its anode re-

sistance increases and the current through the primary winding 1-2-3 decreases to such an extent that the secondary voltage of Tr2, filament voltage, decreases and takes its original value. Owing to the directly heated bridge valve Rö18 whose anode resistance varies practically instantaneously with a change in filament voltage, the original filament voltage is restored within a few tenths of a second. Hence even short a-c supply fluctuations do not influence the amplification and oscillator frequency; this is especially true since the oscillator and amplifier valves are indirectly heated and, therefore, react much slower than Rö18.

4. Preparation for Use

4.1 Setting the Mechanical Zero on the Meters

With the set switched off the pointers of the two meters should be at their mechanical zeros. This is at the l.h. scale end on both meters and marked 0. The slotted screws recessed in the meter housings serve for correction.

4.2 Adjusting the Type USVD to the Local Supply Voltage and Switching On

The set leaves our factory adjusted for operation from a 220-v a-c supply voltage. To adapt it for operation from 115 v, 125 v, or 235 v, loosen the cheese-head screws at the left- and right-hand edges of the front panel, remove the set from its cabinet, and put a suitable fuse into the clips marked with the local supply voltage on the fuse strip in the rear of the set. For 220 v a 1-amp fuse has been inserted. This is also sufficient for 235 v. Use a 2-amp fuse for 125 v or 115 v.

Place the set back into its cabinet, connect it to the a-c supply, and switch on with the toggle switch in the lower r.h. corner. The small neon lamp above the power switch indicates the presence of a-c supply voltage. To prevent the pointer of the small meter from going off scale when the oscillator functions, turn the knob OSC. AMPLITUDE to the left. Allow a certain warm-up period if the measurement must be accurate. A satisfactory thermal equilibrium will be reached after about one hour.

4.3 Connecting the Test Item

A coaxial cable of 50 to 75 Ω characteristic impedance and equipped with an R&S connector Dezifix B should be connected between the Type USVD input and the item to be tested—attenuator, filter, amplifier, slotted line, etc. The r-f voltage applied to the Type USVD input should not exceed approximately 0.5 v, otherwise the crystal diodes of the mixer stage may be damaged. Overloading, if any, is shown by an off scale deflection on the small meter. A d-c or low-frequency voltage is kept away from the mixer stage by the built-in high-pass filter; hence, such a voltage does not affect the performance of the Type USVD. However, care should be taken to ensure that the current at the input does not increase above about 100 ma; a higher current might damage the first coil of the high-pass filter.

For the accurate measurement of, say, the attenuation of a filter it is necessary that the characteristic impedances Z_o of the test-receiver input and the generator output be equal to the rated characteristic impedance of the item under test, e.g. $Z_o = 60$ Ω. The test receiver satisfies this requirement if an attenuator pad of proper characteristic impedance and at least 10 db attenuation is inserted between the Type USVD input and the item under test. Suitable attenuators can be ordered from ROHDE & SCHWARZ. No attenuator is required if the Type USVD is used in conjunction with our UHF Slotted Line Type LMD (BN 3926).

5. Operating Instructions

5.1 Tuning

The knob marked TUNING serves to adjust the set for the given test frequency, 280 to 4600 mc. A flywheel drive with a gear ratio of 1 : 200 permits rapid coverage of the entire frequency range and very sharp tuning. The lever below the tuning knob enables applying a brake to the flywheel. For coarse adjustment this lever should first be set to FREE and then thrown to BRAKED for the fine adjustment.

Since the mixer has a wide-band input a pointer deflection is obtained at two points of the frequency scale for each input frequency. The spacing

between these points is always twice the i-f, i.e. 50 mc. The frequency dial has three graduations calibrated in received frequencies (f_{in}): the first one has two inscriptions referring to $f_{in} = f_{osc} - f_{if}$ and $f_{in} = f_{osc} + f_{if}$, corresponding to the ranges 280 to 890 mc and 330 to 940 mc; the second one refers to $f_{in} = 3\ f_{osc} + f_{if}$ and the third one to $f_{in} = 5\ f_{osc} + f_{if}$ corresponding to the ranges 940 to 2700 mc and 1600 to 4600 mc, respectively.

At input frequencies yielding the intermediate frequency with the third or fifth harmonic of the oscillator frequency, different pointer deflections may be observed at the two possible receiving points, e.g. $f_{in} = 3\ f_{osc} + f_{if}$ and $f_{in} = 3\ f_{osc} - f_{if}$; this is due to the differing sensitivity. In this case it is not necessary to set the frequency dial to the received frequency. Instead, choose the adjustment at which the test receiver is at maximum sensitivity.

When turning the frequency dial take care to prevent the pointer of the small meter from going off scale, otherwise the crystal diode of the mixer stage may be overloaded. Hence, first back off the control OSC. AMPLITUDE sufficiently. After the coarse adjustment to the received frequency adjust this control for a pointer deflection within the scale mark—about 1 cm wide—of the small meter.

5.2 Presetting and Measuring Instructions

(a) Throw the switch SCALE/NO EXTENSION/EXTENDED to NO EXTENSION. This switch normally remains in this position. The reading is to be taken on the scale calibrated 0.3 to 1 of the large meter. The position EXTENDED should be chosen only if a small voltage ratio ($E_{min}/E_{max} >$ 0.7 or < 3 db) that can be read directly from the scale calibrated 0.7 to 1 is to be measured and the accuracy required is not better than ± 10 % of the db value under test.

(b) Adjust the frequency dial to the given test frequency.

(c) Adjust the knob OSC. AMPLITUDE for a pointer deflection within the scale mark of the small meter.

(d) Set the attenuator to 0 DB.

(e) Put the switch IF GAIN COARSE to step 5 and turn the control IF GAIN FINE clockwise until the pointer of the large meter moves to the right

edge of the blue scale mark. The Type USVD input must not be open in this case; on the other hand, no voltage higher than the noise level must be applied to it; i.e. the generator should be connected with its output voltage reduced to a maximum value of 1 µv.

With these adjustments made the mixer works under optimum conditions and the gain is so adjusted that the noise does not exceed a value still permissible for accurate measurements. If then an r-f voltage causing a pointer deflection of 0.7 is applied to the Type USVD input, this voltage represents the lower limit of the measurement range at which an accurate measurement of a voltage ratio is possible. By mixing the fundamental wave of the oscillator with the test frequency, i.e. in the range 280 to 940 mc, a measurement range of 60 db from this value can be covered. This corresponds to the limits of 30 µv and 30 mv at the input of the Type USVD. With an attenuator connected ahead of the Type USVD, these limits are raised in accordance with the db value; for example, they will be at 300 µv and 300 mv, if a 20-db attenuator pad is used.

In the frequency range of 940 to 4600 mc, i.e. by mixing with the 3rd or 5th harmonic of the oscillator, the measurement range is narrowed down by about 20 db owing to the higher attenuation. Accordingly, an accurate measurement without attenuator pad should, in this case, be started from the lower limit of 300 µv. The upper limit lies again at 30 mv since at higher voltages a variation of the input voltage would not involve an accurately proportional variation of the i-f voltage.

5.3 Attenuation Measurement

The measurement is made in two steps according to Figures 1a and 1b. In the first step the measurement is made with the item to be tested connected according to Fig. 1a, in the second step it is made without the item under test, according to Fig. 1b.

(a) Insert the item under test as shown in Fig. 1a, between the signal generator and the 10-db attenuator pad, setting the attenuator to 0 db and the SCALE switch to the position NO EXTENSION. Leave the i-f gain adjusted as described under 5.2 (e). Tune to the test frequency according to section 5.1. Adjust the knob OSC. AMPLITUDE for a pointer deflection within the scale mark of the small meter. Then,

with simultaneous fine tuning of the frequency, adjust the output voltage of the signal generator for a deflection of at least 0.7 on the large meter.

(b) Do not change the adjustments of the generator output voltage, of the osc. amplitude, and of the two knobs for the i-f gain any longer. In the second step of the measurement, first set the attenuator to about 60 db, disconnect the unknown and connect the generator directly to the 10-db pad; then vary the attenuator setting until the large meter shows the same deflection as during the first step of the measurement. It is recommended that the frequency tuning be checked and, if necessary, corrected. The attenuation (x db) of the unknown is then equal to the value set on the attenuator. Measuring the frequency response of the attenuation by this method is, of course, rather tedious as the cables must be disconnected at each measuring point. To avoid this difficulty, first measure the frequency response of the Type USVD with the 10-db pad in the frequency range involved and next determine the frequency response with the test item connected. This method requires a signal generator permitting accurate settings and reading of the output voltage. Suitable signal generators are the R&S types SDR (300 to 1000 mc), SCR (1000 to 1900 mc), and SBR (1600 to 2400 mc). The frequency response of the test item is obtained as the difference between the value measured with the test item connected and the one obtained with the test item removed.

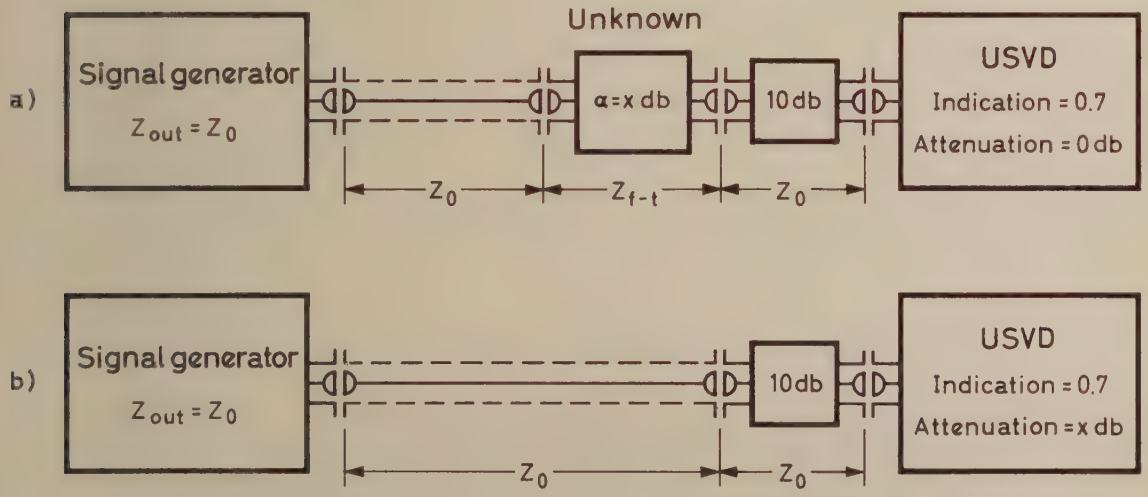


Fig. 1. Measuring the attenuation of a four-terminal network

The two frequency responses should be measured with the frequency dial at the same setting. The reason for this is that the Type USVD may show a different sensitivity at the two possible settings, in particular when mixing takes place with the 3rd or 5th harmonic of the oscillator frequency. This means that it is not permissible to adjust once for, say, $f_{in} = 3\ f_{osc} + f_{if}$ and in the second step of the measurement for $f_{in} = 3\ f_{osc} - f_{if}$. It is advantageous to choose a setting where the Type USVD shows the higher sensitivity.

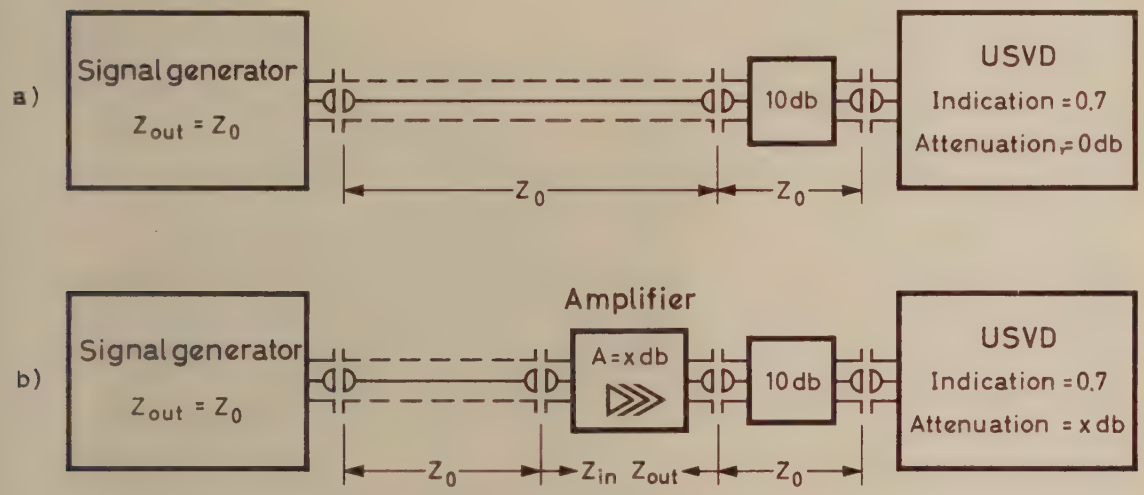


Fig. 2. Measurement of gain

5.4 Gain Measurement

The measuring method is the same as described under 5.3 for attenuation measurements, however, in this case the measurement is first made without the amplifier and then with the amplifier. The test setup is shown in Fig. 2. To determine the frequency response of the gain, one first measures the frequency response without amplifier according to Fig. 2a and then with the amplifier inserted as shown in Fig. 2b; the frequency response of the amplifier is the difference of the two values.

5.5 The Type USVD as Indicator for Slotted Lines

If high voltage ratios are to be measured and the item under test is such that only low voltages can be applied from the generator to the slotted line, the Type USVD input should be directly connected to the probe without inserting a 10-db pad. To ensure a minimum of noise the probe should have a purely resistive output impedance of about 50 to 75 Ω. With the Type USVD input open, or with a purely reactive output impedance of the voltage source, the noise in the mixer might become so strong that the full measurement range of ≦ 60 db is reduced. The noise due to mismatch can be recognized if the generator is switched off while the probe remains connected to the Type USVD input.

For rapid coarse measurements of low voltage ratios one can, without using the attenuator, read the VSWR directly from the 0.3 to 1 scale of the large meter. Here the range below 0.7 can be used only if the noise of the i-f amplifier is suppressed so far that the pointer of the meter is not at the r.h. edge of the blue scale mark but approximately at 0, with the attenuator set for 60 db. The controls IF GAIN FINE and IF GAIN COARSE will serve this adjustment.

Low voltage ratios can be read somewhat more accurately and easily from the scale calibrated 0.7 to 1. To this end the switch below the large meter should be on EXTENDED. The scales are identical in that, at a given input voltage the pointer deflection, but not the indicated value, will be different if the switch is thrown to the other position.

5.6 Use of the Outputs

The characteristics of the i-f output and of the three a-f outputs are given in section 1. The output "IF", for instance, can be used to connect the R&S Frequency Deviation Meter Type FMV, 20 to 300 mc, for accurate measurements of the frequency deviation and percentage modulation of UHF generators. A coaxial 60-Ω cable with R&S connectors Dezifix B at both ends should be used. The voltage available at the output AF I, 60 v_{pp}, is sufficient to excite a cathode-ray tube without amplification. If in this case it is intended to utilize the upper cut-off frequency of 200 kc the capacitive load should be kept as low as possible. Hence the cable used should be short, of low capacitance, and have a 13-mm plug, FS 413/11, for connection to the Type USVD. To obtain an undistorted display it may be necessary to set the switch IF GAIN COARSE for a sufficiently small i-f gain.

Also possible is the connection of an oscilloscope, with amplifier, to the broadband output AF II. In this case the connecting cable should be a coaxial 75-Ω (or 60-Ω) cable with a 13-mm plug, DS 413/11. The output AF III enables the connection of headphones. The control above the jacks permits continuous variation of the output voltage. R-f voltages of the order of 1 µv are still discernible if the carrier is 100 % modulated. Thus the Type USVD can be used with advantage as a zero indicator, for example, of the R&S Reflectometer Type ZUP, 10 to 600 mc, or the R&S UHF Slotted Line Type LMD, 300 to 3000 mc, in measurements according to the double minimum method.

6. Replacement of Valves

The valves Rö2 to Rö7, 6 x EF 80, of the i-f and a-f amplifiers can be replaced by the same type, no further adjustment being necessary.

To replace the oscillator valve Rö1, EC 55, first loosen the tension band and remove the shield. Next, slacken off the two screws on the valve bracket and remove the clamping ring holding the valve in position. Withdraw the valve carefully. When inserting the new valve take care to ensure that the heater pin is accurately aligned with the contact socket. Push the valve gently and completely into its socket, then refit the clamping ring. Replace the shield and tighten the tension band. Check that the oscillator functions satisfactorily throughout the frequency range. This is indicated by the pointer deflection of the small meter with the control OSC. AMPLITUDE fully advanced. At all frequencies, 305 to 915 mc, the deflection should be within the scale mark.

The two mixer diodes G11 and G12 can be replaced after the tension band at the mixer has been loosened and the shielding hood removed. They must always be replaced in matched pairs. A matched pair can be ordered by quoting the stock number GK 1012 C and the serial number of the set for which it is to be used.

After replacement of Rö15, PL 81, Rö13, EF 40, and Rö14, 85 A 1, in the power section of the oscillator, the anode supply voltage, 300 v, should be checked and, if necessary, adjusted to its rated value. The sockets

marked 300 V on the rear of the set serve this measurement. The control R159 also provided on the rear serves to adjust the anode voltage.

Proceed correspondingly after replacement of valves Rö8, PL 81, Rö9, PL 81, Rö10, EF 40, and Rö11, 85 A 1, for stabilization of the anode voltage of the i-f and a-f amplifier. In this case use the sockets marked 190 V and the control R143. Furthermore, check that the indicated value is the same on both ranges of indication, 0.3 to 1 and 0.7 to 1, of the large meter. To this end, apply an r-f voltage yielding the reading 1 in the switch position NO EXTENSION. After switching over to EXTENDED the reading 1 should be reobtained. If this is not the case the control R136 should be adjusted correspondingly.

After replacement of Rö16, PL 81, Rö17, EF 40, and Rö18, DL 41, for stabilization of the filament voltages of Rö1 to Rö7, measure the voltage at the sockets marked 6.35 V on the rear of the set and, if necessary, readjust to the nominal value of 6.35 v by means of the controls R172, (coarse adjustment) and R173 (fine adjustment). The anode resistance of Rö18 may vary slightly when the instrument is first used and thus cause the filament voltage to change also. Hence it is recommended that this adjustment be repeated after an operating time of about 20 hours.

The current regulator valve Rö12, PL 81, which for direct current is in series with the oscillator valve Rö1, can ordinarily be replaced by the same type. In an exceptional case it may be necessary to readjust the control R150 to restore the original anode resistance in Rö12. It should be ensured that with the control OSC. AMPLITUDE, R189, fully advanced the oscillator amplitude is sufficient at all frequencies.

7. Table of Replaceable Parts

(Änd.-Zust. „f" Nr. 5427)

Ref. No.	Designation	Ratings	R&S Stock No.
C1	Capacitor, tubular	6 µµf ± 10 %	incl. in 1523 - 2
C3	Capacitor, bypass	30 µµf ± 5 %	incl. in 1523 - 2
C4	Capacitor, bypass	30 µµf ± 5 %	incl. in 1523 - 2
C5	Trimmer, tubular, ceramic	1...6 µµf	CV 7205
C6	Trimmer, tubular, ceramic	1...6 µµf	CV 7205
C7	Capacitor, synth. foil	5000 µµf/125 v	2 x CKS 2500/125 parallel
C8	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C9	Capacitor, feed-through, ceramic	5000 µµf/500 v	1523 - 2.25 mod. of CFR 1/5000/500
C10	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C12	Trimmer, air	approx. 3 µµf	incl. in 1523 - 7
C13	Trimmer, air	approx. 6 µµf	incl. in 1523 - 7
C14	Trimmer, air	approx. 6 µµf	incl. in 1523 - 7
C15	Trimmer, air	approx. 3 µµf	incl. in 1523 - 7
C17	Capacitor		incl. in 1523 - 1
C18	Capacitor, variable	C_{max} = 18.5 µµf	incl. in 1523 - 1
C19	Capacitor, bypass	12 µµf ± 10 %	incl. in 1523 - 1
C20	Capacitor		incl. in 1523 - 1
C21	Capacitor, bypass	100 µµf ± 20 %	incl. in 1523 - 1
C22	Capacitor, bypass	100 µµf ± 20 %	incl. in 1523 - 1
C23	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C24	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C25	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500

Ref. No.	Designation	Ratings	R&S Stock No.
C26	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C29	Capacitor, synth. foil	2500 µµf/125 v	CKS 2500/125
C30	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C31	Trimmer, tubular, ceramic	1...6 µµf	CV 7205
C32	Capacitor, synth. foil	2500 µµf/250 v	CKS 2500/250
C33	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C34	Capacitor, synth. foil	500 µµf/500 v	CKS 500/500
C35	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C36	Capacitor, synth. foil	2500 µµf/125 v	CKS 2500/125
C37	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C39	Trimmer, tubular, ceramic	1...6 µµf	CV 7205
C40	Capacitor, synth. foil	2500 µµf/250 v	CKS 2500/250
C41	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C42	Capacitor, synth. foil	500 µµf/500 v	CKS 500/500
C43	Capacitor, synth. foil	2500 µµf/125 v	CKS 2500/125
C44	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C46	Trimmer, tubular, ceramic	1...6 µµf	CV 7205
C47	Capacitor, synth. foil	2500 µµf/250 v	CKS 2500/250
C48	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C49	Capacitor, synth. foil	500 µµf/500 v	CKS 500/500
C50	Capacitor, synth. foil	2500 µµf/125 v	CKS 2500/125
C51	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C53	Trimmer, tubular, ceramic	1...6 µµf	CV 7205

Ref. No.	Designation	Ratings	R&S Stock No.
C54	Capacitor, synth. foil	2500 µµf/250 v	CKS 2500/250
C55	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C56	Capacitor, ceramic	10 µµf	CCH 31/10
C57	Trimmer, tubular, ceramic	1...11 µµf	CV 7210
C58	Capacitor, ceramic	27 µµf	CCH 31/27
C59	Capacitor, synth. foil	2500 µµf/125 v	CKS 2500/125
C60	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C61	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C63	Capacitor, synth. foil	2500 µµf/250 v	CKS 2500/250
C64	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C65	Capacitor, bypass	160 µµf ± 10 %	incl. in 1523 - 3
C67	Capacitor, paper	50,000 µµf/250 v	CPK 50 000/250
C68	Capacitor, paper	100,000 µµf/630 v	CPK 100 000/630
C69	Capacitor, paper	25,000 µµf/250 v	CPK 25 000/250
C70	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C72	Capacitor, synth. foil	2500 µµf/125 v	CKS 2500/125
C73	Capacitor, synth. foil	2500 µµf/125 v	CKS 2500/125
C74	Capacitor, synth. foil	2500 µµf/125 v	CKS 2500/125
C75	Capacitor, synth. foil	2500 µµf/125 v	CKS 2500/125
C76	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C77	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C78	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C79	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500

Ref. No.	Designation	Ratings	R&S Stock No.
C82	Capacitor, MP	1 µf/160 v	CMR 1/160
C83	Capacitor, MP	1 µf/250 v	CMR 1/250
C84	Capacitor, MP	1 µF/160 v	CMR 1/160
C86	Capacitor, MP	2 µf/160 v	CMR 2/160/2
C87	Capacitor, MP	16 µf/350 v	CMR 16 + 16/350
C88	Capacitor, MP	16 µf/350 v	
C89	Capacitor, MP	8 µf/500 v	CMR 8/500
C90	Capacitor, MP	16 µf/250 v	CMR 16/250
C91	Capacitor, MP	16 µf/250 v	CMR 16/250
G11	Diode, crystal		GK 1012 C
G12	Diode, crystal		
G13	Diode, crystal		GK 2371
G14	Diode, crystal		GK 2551
G15	Diode, crystal		GK 2551
G16	Rectifier, power	2 x 360 v/85 ma	GN 19/720/85 M
G17			
G18	Rectifier, power	2 x 360 v/85 ma	GN 19/720/85 M
G19			
G110	Rectifier, power	2 x 360 v/85 ma	GN 19/720/85 M
G111			
I1	Ammeter, moving-coil		INS 10404
I2	Ammeter, moving-coil		INS 30402
K1	Cable, r-f	Z = 60 Ω	1523 - 18
K2	Cable, r-f	Z = 60 Ω	1523 - 19
K3	Cable, r-f	Z = 60 Ω	1523 - 20
K4	Cable, r-f	Z = 60 Ω	1523 - 20
K5	Cable, r-f	Z = 60 Ω	1523 - 21
K6	Cable, r-f	Z = 60 Ω	1523 - 22
K7	Cable, r-f	Z = 60 Ω	1523 - 23

Ref. No.	Designation	Ratings	R&S Stock No.
K8	Cable, r-f	Z = 150 Ω	1523 - 24
K9	Cable, r-f	Z = 60 Ω	1523 - 26
K20	Cable, connecting		LK 303
L1	Coil, (high-pass filter)		1523 - 2.32
L2	Coil, (high-pass filter)		1523 - 2.32
L4 L5 L6	Balanced line		incl. in 1523 - 2
L7	Transformer, i-f		1523 - 2.40
L8	Transformer, i-f		1523 - 2.41
L9	Choke		1523 - 1.75
L10	Choke		1523 - 1.75
L12	Coil		incl. in 1523 - 7
L13	Coil		incl. in 1523 - 7
L14	Coil		incl. in 1523 - 7
L16	Loop, coupling		incl. in 1523 - 1
L17 L18	Tunable resonator		incl. in 1523 - 1
L19	Choke		1523 - 1.76
L20	Choke		1523 - 1.76
L21	Choke		1523 - 1.75
L22	Choke		1523 - 1.75
L23	Choke		1523 - 1.75
L24	Choke		1523 - 1.75
L27	Coil		1523 - 3.8
L28	Choke		DUF 311/20
L29	Coil		1523 - 3.9
L30	Choke		DUF 311/20

Ref. No.	Designation	Ratings	R&S Stock No.
L31	Coil		1523 - 3.10
L32	Choke		DUF 311/20
L33	Coil		1523 - 3.9
L34	Choke		DUF 311/20
L35	Transformer, i-f		1523 - 3.11
L36	Choke		DUF 311/20
L37	Transformer, i-f		1523 - 3.12
L38	Coil, (low-pass filter)		1523 - 3.13
L39	Coil, (low-pass filter)		1523 - 3.13
L41	Choke		DUF 311/20
L42	Choke		DUF 311/20
L43	Choke		DUF 311/20
L44	Choke		DUF 311/20
L45	Choke		DUF 311/20
L46	Choke		DUF 311/20
L47	Choke		DUF 311/20
L48	Choke		DUF 311/20
L49	Choke		DUF 311/20
L50	Choke		DUF 311/20
L51	Choke		DUF 311/20
L52	Choke		DUF 311/20
L53	Choke		DUF 311/20
L56	Choke		DB 125/2
L57	Choke		DB 75/2
R1	Resistor, depos. carbon	100 Ω/0.25 w	WFK 511/100/0,25
R2	Resistor, depos. carbon	40 Ω ± 1 %/0.5 w	WF 40/1/0,5
R3	Resistor, depos. carbon	16 kΩ ± 1 %/0.5 w	WF 16 k/1/0,5

Ref. No.	Designation	Ratings	R&S Stock No.
R6	Resistor, depos. carbon	0.69 Ω/0.25 w	WFS 1/0,69/0,25
R7	Resistor, depos. carbon	0.69 Ω/0.25 w	WFS 1/0,69/0,25
R8	Resistor, depos. carbon	0.69 Ω/0.25 w	WFS 1/0,69/0,25
R9	Resistor, depos. carbon	0.69 Ω/0.25 w	WFS 1/0,69/0,25
R10	Resistor, depos. carbon	0.69 Ω/0.25 w	WFS 1/0,69/0,25
R11	Resistor, depos. carbon	0.69 Ω/0.25 w	WFS 1/0,69/0,25
R12	Resistor, depos. carbon	0.69 Ω/0.25 w	WFS 1/0,69/0,25
R13	Resistor, depos. carbon	0.69 Ω/0.25 w	WFS 1/0,69/0,25
R14	Resistor, depos. carbon	0.69 Ω/0.25 w	WFS 1/0,69/0,25
R15	Resistor, depos. carbon	0.69 Ω/0.25 w	WFS 1/0,69/0,25
R16	Resistor, depos. carbon	10.4 kΩ/0.25 w	WFS 1/10,4 k/0,25
R17	Resistor, depos. carbon	10.4 kΩ/0.25 w	WFS 1/10,4 k/0,25
R18	Resistor, depos. carbon	10.4 kΩ/0.25 w	WFS 1/10,4 k/0,25
R19	Resistor, depos. carbon	10.4 kΩ/0.25 w	WFS 1/10,4 k/0,25
R20	Resistor, depos. carbon	10.4 kΩ/0.25 w	WFS 1/10,4 k/0,25
R21	Resistor, depos. carbon	10.4 kΩ/0.25 w	WFS 1/10,4 k/0,25
R22	Resistor, depos. carbon	10.4 kΩ/0.25 w	WFS 1/10,4 k/0,25
R23	Resistor, depos. carbon	10.4 kΩ/0.25 w	WFS 1/10,4 k/0,25
R24	Resistor, depos. carbon	10.4 kΩ/0.25 w	WFS 1/10,4 k/0,25
R25	Resistor, depos. carbon	10.4 kΩ/0.25 w	WFS 1/10,4 k/0,25
R26	Resistor, depos. carbon	10.4 kΩ/0.25 w	WFS 1/10,4 k/0,25
R27	Resistor, depos. carbon	10.4 kΩ/0.25 w	WFS 1/10,4 k/0,25
R28	Resistor, depos. carbon	10.4 kΩ/0.25 w	WFS 1/10,4 k/0,25
R29	Resistor, depos. carbon	10.4 kΩ/0.25 w	WFS 1/10,4 k/0,25
R30	Resistor, depos. carbon	10.4 kΩ/0.25 w	WFS 1/10,4 k/0,25
R31	Resistor, depos. carbon	10.4 kΩ/0.25 w	WFS 1/10,4 k/0,25
R32	Resistor, depos. carbon	10.4 kΩ/0.25 w	WFS 1/10,4 k/0,25

Ref. No.	Designation	Ratings	R&S Stock No.
R33	Resistor, depos. carbon	10.4 kΩ/0.25 w	WFS 1/10,4 k/0,25
R34	Resistor, depos. carbon	10.4 kΩ/0.25 w	WFS 1/10,4 k/0,25
R35	Resistor, depos. carbon	10.4 kΩ/0.25 w	WFS 1/10,4 k/0,25
R36	Resistor, depos. carbon	6.915Ω±0.5%/0.25 w	WFS 1/6,915/0,5/0,25
R37	Resistor, depos. carbon	6.915Ω±0.5%/0.25 w	WFS 1/6,915/0,5/0,25
R38	Resistor, depos. carbon	6.915Ω±0.5%/0.25 w	WFS 1/6,915/0,5/0,25
R39	Resistor, depos. carbon	6.915Ω±0.5%/0.25 w	WFS 1/6,915/0,5/0,25
R40	Resistor, depos. carbon	6.915Ω±0.5%/0.25 w	WFS 1/6,915/0,5/0,25
R41	Resistor, depos. carbon	6.915Ω±0.5%/0.25 w	WFS 1/6,915/0,5/0,25
R42	Resistor, depos. carbon	6.915Ω±0.5%/0.25 w	WFS 1/6,915/0,5/0,25
R43	Resistor, depos. carbon	6.915Ω±0.5%/0.25 w	WFS 1/6,915/0,5/0,25
R44	Resistor, depos. carbon	6.915Ω±0.5%/0.25 w	WFS 1/6,915/0,5/0,25
R45	Resistor, depos. carbon	6.915Ω±0.5%/0.25 w	WFS 1/6,915/0,5/0,25
R46	Resistor, depos. carbon	1.045 kΩ±0.5%/0.25w	WFS 1/1,045 k/0,5/0,25
R47	Resistor, depos. carbon	1.045 kΩ±0.5%/0.25w	WFS 1/1,045 k/0,5/0,25
R48	Resistor, depos. carbon	1.045 kΩ±0.5%/0.25w	WFS 1/1,045 k/0,5/0,25
R49	Resistor, depos. carbon	1.045 kΩ±0.5%/0.25w	WFS 1/1,045 k/0,5/0,25
R50	Resistor, depos. carbon	1.045 kΩ±0.5%/0.25w	WFS 1/1,045 k/0,5/0,25
R51	Resistor, depos. carbon	1.045 kΩ±0.5%/0.25w	WFS 1/1,045 k/0,5/0,25
R52	Resistor, depos. carbon	1.045 kΩ±0.5%/0.25w	WFS 1/1,045 k/0,5/0,25
R53	Resistor, depos. carbon	1.045 kΩ±0.5%/0.25w	WFS 1/1,045 k/0,5/0,25
R54	Resistor, depos. carbon	1.045 kΩ±0.5%/0.25w	WFS 1/1,045 k/0,5/0,25
R55	Resistor, depos. carbon	1.045 kΩ±0.5%/0.25w	WFS 1/1,045 k/0,5/0,25
R56	Resistor, depos. carbon	1.045 kΩ±0.5%/0.25w	WFS 1/1,045 k/0,5/0,25
R57	Resistor, depos. carbon	1.045 kΩ±0.5%/0.25w	WFS 1/1,045 k/0,5/0,25
R58	Resistor, depos. carbon	1.045 kΩ±0.5%/0.25w	WFS 1/1,045 k/0,5/0,25
R59	Resistor, depos. carbon	1.045 kΩ±0.5%/0.25w	WFS 1/1,045 k/0,5/0,25

Ref. No.	Designation	Ratings	R&S Stock No.
R60	Resistor, depos. carbon	1.045 kΩ±0.5%/0.25w	WFS 1/1,045 k/0,5/0,25
R61	Resistor, depos. carbon	1.045 kΩ±0.5%/0.25w	WFS 1/1,045 k/0,5/0,25
R62	Resistor, depos. carbon	1.045 kΩ±0.5%/0.25w	WFS 1/1,045 k/0,5/0,25
R63	Resistor, depos. carbon	1.045 kΩ±0.5%/0.25w	WFS 1/1,045 k/0,5/0,25
R64	Resistor, depos. carbon	1.045 kΩ±0.5%/0.25w	WFS 1/1,045 k/0,5/0,25
R65	Resistor, depos. carbon	1.045 kΩ±0.5%/0.25w	WFS 1/1,045 k/0,5/0,25
R66	Resistor, depos. carbon	85.25 Ω±0.5%/0.25 w	WFS 1/85,25/0,5/0,25
R67	Resistor, depos. carbon	85.25 Ω±0.5%/0.25 w	WFS 1/85,25/0,5/0,25
R68	Resistor, depos. carbon	85.25 Ω±0.5%/0.25 w	WFS 1/85,25/0,5/0,25
R69	Resistor, depos. carbon	85.25 Ω±0.5%/0.25 w	WFS 1/85,25/0,5/0,25
R70	Resistor, depos. carbon	85.25 Ω±0.5%/0.25 w	WFS 1/85,25/0,5/0,25
R71	Resistor, depos. carbon	85.25 Ω±0.5%/0.25 w	WFS 1/85,25/0,5/0,25
R72	Resistor, depos. carbon	115.6 Ω±0.5%/0.25 w	WFS 1/115,6/0,5/0,25
R73	Resistor, depos. carbon	115.6 Ω±0.5%/0.25 w	WFS 1/115,6/0,5/0,25
R74	Resistor, depos. carbon	115.6 Ω±0.5%/0.25 w	WFS 1/115,6/0,5/0,25
R75	Resistor, depos. carbon	115.6 Ω±0.5%/0.25 w	WFS 1/115,6/0,5/0,25
R76	Resistor, depos. carbon	115.6 Ω±0.5%/0.25 w	WFS 1/115,6/0,5/0,25
R77	Resistor, depos. carbon	115.6 Ω±0.5%/0.25 w	WFS 1/115,6/0,5/0,25
R78	Resistor, depos. carbon	115.6 Ω±0.5%/0.25 w	WFS 1/115,6/0,5/0,25
R79	Resistor, depos. carbon	115.6 Ω±0.5%/0.25 w	WFS 1/115,6/0,5/0,25
R80	Resistor, depos. carbon	115.6 Ω±0.5%/0.25 w	WFS 1/115,6/0,5/0,25
R81	Resistor, depos. carbon	115.6 Ω±0.5%/0.25 w	WFS 1/115,6/0,5/0,25
R82	Resistor, depos. carbon	115.6 Ω±0.5%/0.25 w	WFS 1/115,6/0,5/0,25
R83	Resistor, depos. carbon	115.6 Ω±0.5%/0.25 w	WFS 1/115,6/0,5/0,25
R86	Resistor, depos. carbon	60 Ω ± 1 %/0.25 w	WFK 511/60/1/0,25
R87	Resistor, depos. carbon	2.5 kΩ/0.5 w	WFO 2,5 k/0,5
R90	Resistor, depos. carbon	65 Ω ± 0.5 %/0.25 w	WF 65/0,5/0,25

Ref. No.	Designation	Ratings	R&S Stock No.
R125	Resistor, depos. carbon	6 kΩ/1 w	WF 6 k/1
R126	Resistor, depos. carbon	4 kΩ/0.5 w	WF 4 k/0,5
R127	Resistor, depos. carbon	4 kΩ/0.5 w	WF 4 k/0,5
R130	Resistor, depos. carbon	1 kΩ/0.5 w	WF 1 k/0,5
R131	Resistor, depos. carbon	1 kΩ/0.5 w	WF 1 k/0,5
R132	Resistor, depos. carbon	1 kΩ/0.5 w	WF 1 k/0,5
R133	Resistor, depos. carbon	1 kΩ/0.5 w	WF 1 k/0,5
R136	Resistor, depos. carbon, variable	50 kΩ lin.	WS 9122 F/50 k
R137	Resistor, depos. carbon	80 kΩ/0.5 w	WF 80 k/0,5
R138	Resistor, depos. carbon	300 Ω/0.5 w	WF 300/0,5
R139	Resistor, depos. carbon	10 kΩ/0.5 w	WF 10 k/0,5
R140	Resistor, depos. carbon	10 kΩ/0.5 w	WF 10 k/0,5
R141	Resistor, depos. carbon	1 MΩ/0.5 w	WF 1 M/0,5
R142	Resistor, depos. carbon	100 kΩ/0.5 w	WF 100 k/0,5
R143	Resistor, depos. carbon, variable	100 kΩ lin.	WS 9122 F/100 k
R144	Resistor, depos. carbon	100 kΩ/0.5 w	WF 100 k/0,5
R145	Resistor, depos. carbon	1 kΩ/0.5 w	WF 1 k/0,5
R146	Resistor, depos. carbon	1 kΩ/0.5 w	WF 1 k/0,5
R149	Resistor, depos. carbon	1 kΩ/0.5 w	WF 1 k/0,5
R150	Resistor, depos. carbon, variable	500 Ω lin.	WS 9122 F/500
R151	Resistor, depos. carbon	1 kΩ/0.5 w	WF 1 k/0,5
R152	Resistor, depos. carbon	50 Ω/0.5 w	WF 50/0,5
R153	Resistor, depos. carbon	30 kΩ/0.5 w	WF 30 k/0,5
R154	Resistor, depos. carbon	10 kΩ/0.5 w	WF 10 k/0,5
R155	Resistor, depos. carbon	1 MΩ/0.5 w	WF 1 M/0,5
R156	Resistor, wire-wound	10 kΩ/6 w	WD 10 k/6

Ref. No.	Designation	Ratings	R&S Stock No.
R157	Resistor, depos. carbon	1 kΩ/0.5 w	WF 1 k/0,5
R158	Resistor, depos. carbon	300 kΩ/0.5 w	WF 300 k/0,5
R159	Resistor, depos. carbon, variable	100 kΩ lin.	WS 9122 F/100 k
R160	Resistor, depos. carbon	100 kΩ/0.5 w	WF 100 k/0,5
R163	Resistor, depos. carbon	10 kΩ/1 w	WF 10 k/1
R164	Resistor, depos. carbon	1 kΩ/0.5 w	WF 1 k/0,5
R165	Resistor, depos. carbon	1 MΩ/0.5 w	WF 1 M/0,5
R166	Resistor, wire-wound	3 kΩ/12 w	2 x WD 6 k/6 parallel
R167	Resistor, depos. carbon	40 kΩ/1 w	WF 40 k/1
R168	Resistor, depos. carbon	500 kΩ/0.5 w	WF 500 k/0,5
R169	Resistor, depos. carbon	10 kΩ/0.5 w	WF 10 k/0,5
R170	Resistor, depos. carbon	100 kΩ/0.5 w	WF 100 k/0,5
R171	Resistor, depos. carbon	100 kΩ/0.5 w	WF 100 k/0,5
R172	Resistor, wire-wound, variable	10 Ω lin.	WR 4 F/10
R173	Resistor, wire-wound, variable	50 Ω lin.	WR 4 F/50
R176	Resistor, depos. carbon, variable	1 kΩ lin.	WS 7126/1 k
R177	Resistor, depos. carbon, variable	10 kΩ lin.	WS 7126/10 k
R178	Resistor, depos. carbon	1 kΩ/0.25 w	WF 1 k/0,25
R179	Resistor, depos. carbon	1.6 kΩ/0.25 w	WF 1,6 k/0,25
R180	Resistor, depos. carbon	400 Ω/0.25 w	WF 400/0,25
R181	Resistor, depos. carbon	400 Ω/0.25 w	WF 400/0,25
R182	Resistor, depos. carbon	400 Ω/0.25 w	WF 400/0,25
R183	Resistor, depos. carbon	400 Ω/0.25 w	WF 400/0,25
R184	Resistor, depos. carbon	400 Ω/0.25 w	WF 400/0,25
R185	Resistor, depos. carbon	200 kΩ/0.5 w	WF 200 k/0,5

Ref. No.	Designation	Ratings	R&S Stock No.
R186	Resistor, depos. carbon	30 kΩ ± 1 %/0.5 w	WF 30 k/1/0,5
R188	Resistor, wire-wound	16 kΩ/6 w	WD 16 k/6
R189	Resistor, depos. carbon, variable	2.5 kΩ lin.	WS 5126/2,5 k
R192	Resistor, depos, carbon	500 kΩ/0.5 w	WF 500 k/0,5
R193	Resistor, depos. carbon	300 kΩ/0.5 w	WF 300 k/0,5
R194	Resistor, depos. carbon	300 kΩ/0.5 w	WF 300 k/0,5
Rl1	Miniature neon lamp	220 v	RL 210
Rö1	Triode, disc-seal		EC 55
Rö2	Pentode		EF 80
Rö3	Pentode		EF 80
Rö4	Pentode		EF 80
Rö5	Pentode		EF 80
Rö6	Pentode		EF 80
Rö7	Pentode		EF 80
Rö8	Pentode, output		PL 81
Rö9	Pentode, output		PL 81
Rö10	Pentode		EF 40
Rö11	Reference tube		85 A 1
Rö12	Pentode, output		PL 81
Rö13	Pentode		EF 40
Rö14	Reference tube		85 A 1
Rö15	Pentode, output		PL 81
Rö16	Pentode, output		PL 81
Rö17	Pentode		EF 40
Rö18	Pentode, output		DL 41

Ref. No.	Designation	Ratings	R&S Stock No.
S1	Switch		18011 - 104/11
S2	Switch		18011 - 104/11
S3	Switch		18011 - 104/7/2
S4	Switch, wafer		SRN 311/2/32
S5	Switch, wafer		SRN 311/2/32
S6	Switch (combination)		SRK 2
S7	Fuse strip		FD 60515
Si1	Fuse	1 amp	1 C DIN 41571
Tr1	Transformer, output		1523 - 3.15
Tr2	Transformer, heater		1523 - 5.6
Tr3	Transformer, power		1523 - 5.7/2

Guarantee

Rohde & Schwarz guarantee

F O R O N E Y E A R

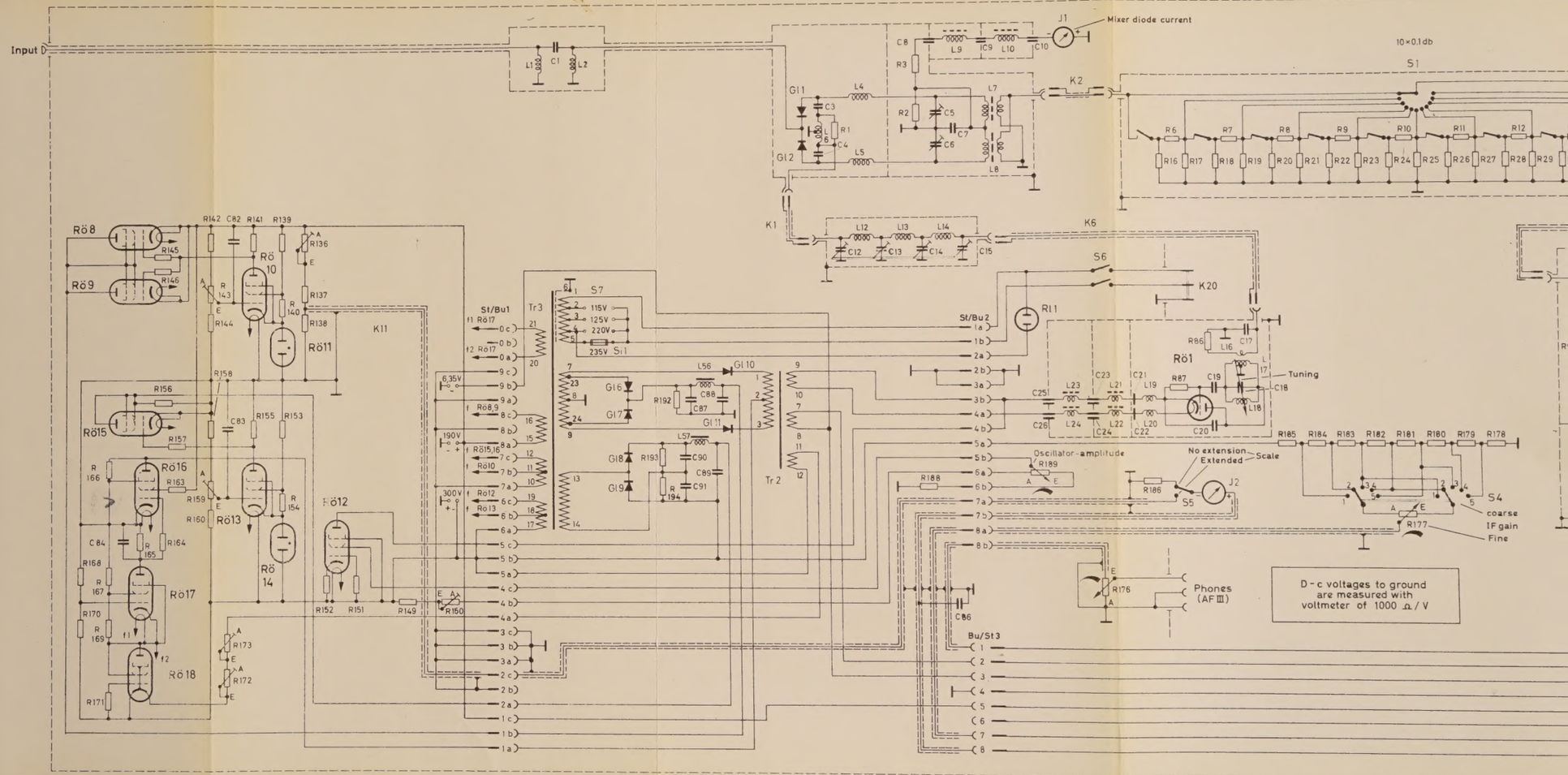
each instrument manufactured and sold by them to be free from defects in material and workmanship, subject to clause 5 of their terms of delivery and payment.

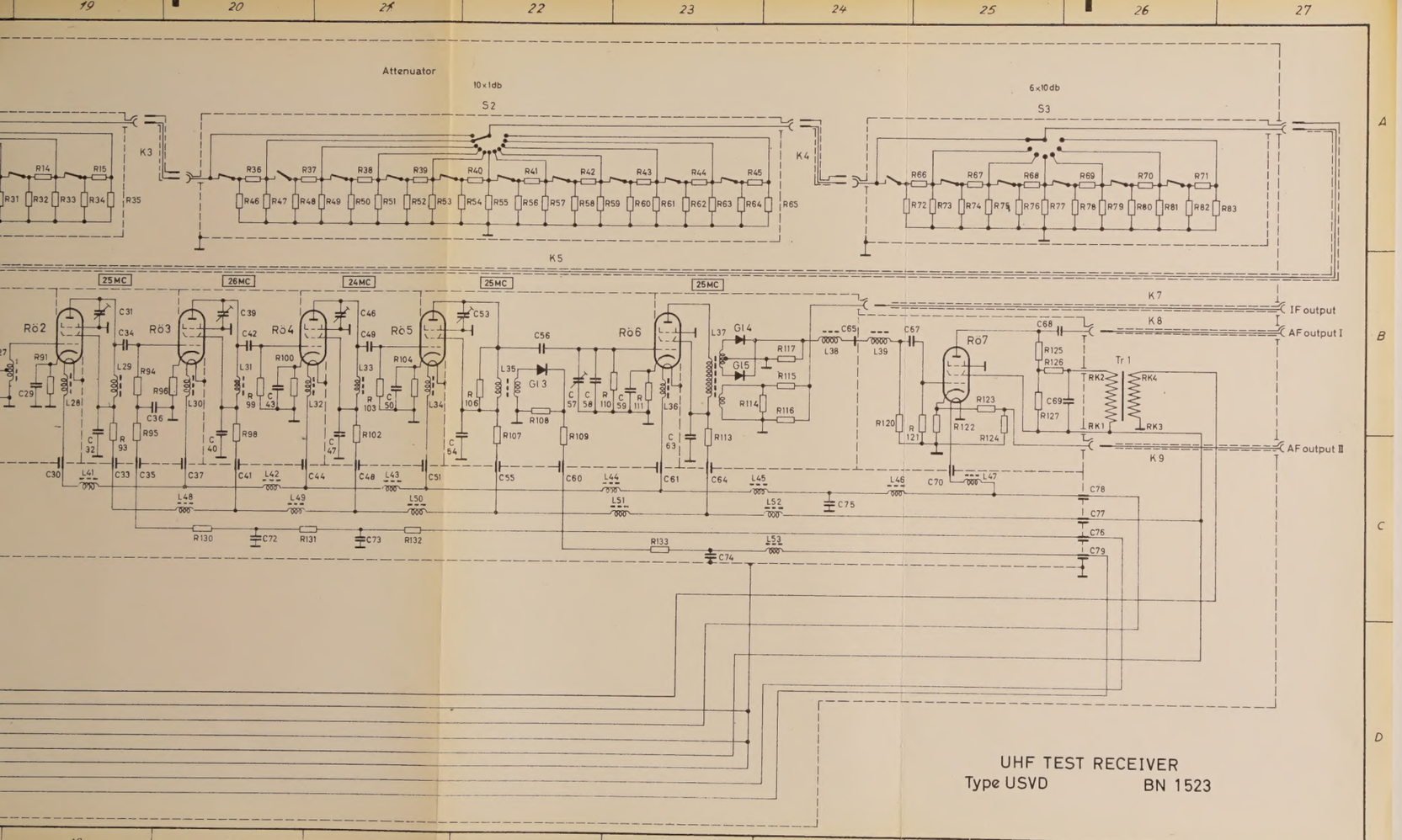
This guarantee does not imply the right to rescind a sale or demand a reduction in purchase price. The firm's obligation under this guarantee is limited to the repair or replacement of the defective part or parts, provided the claim is asserted in writing immediately, or within one week at the latest, after discovery of the defect. The part or parts shall be returned to the factory, with transportation charges prepaid, within one week from the instruction by the firm to do so. The return charges shall likewise be covered by the purchaser. The firm does not assume any liability for damage resulting directly or indirectly from the defect. The guarantee shall be void if the part or parts have been tampered with.

The seals of the instrument shall be undamaged. Rohde & Schwarz guarantee valves for which the purchaser has not received the certificate of guarantee of the manufacturer. Defective valves which are held to be covered by this guarantee shall be returned to the factory for examination. The following details shall be specified:

Number, date and reference of the invoice;
type and serial number (FNr.) of the instrument;
specification of valve defect.

ROHDE & SCHWARZ · München 9 · Tassiloplatz 7


Input
L1
C1
L2
G11
G12
L4
L5
C3
C4
R1
R2
R3
C5
C6
C7
C8
L7
L8
L9
C9
L10
C10
J1
Mixer diode current
K2
10×0.1db
S1
R6
R7
R8
R9
R10
R11
R12
R16
R17
R18
R19
R20
R21
R22
R23
R24
R25
R26
R27
R28
R29
K1
K6
L12
L13
L14
C12
C13
C14
C15
S6
K20
Rö8
Rö9
R142
C82
R141
R139
R136
Rö 10
R145
R146
R143
R144
R137
R138
Rö11
K11
R156
R158
Rö15
R157
C83
R155
R153
Rö16
R166
R163
R159
R160
C84
R165
R164
R168
R167
Rö17
R170
R169
Rö18
f1
f2
R171
R173
R172
Rö 14
Rö12
R152
R151
R149
R150
St/Bu1
Tr3
S7
115V
125V
220V
235V Si1
6,35V
190V
300V
Rö17
Rö8,9
Rö15,16
Rö10
Rö12
Rö13
L56
Gl 10
Gl 11
G16
G17
G18
G19
R192
R193
R194
C87
C88
C89
C90
C91
L57
Tr 2
St/Bu2
Rl1
Rö1
R86
C17
L16
C18
Tuning
C19
R87
C20
C21
C23
L19
L21
C22
C24
L20
L22
C25
C26
L23
L24
R185
R184
R183
R182
R181
R180
R179
R178
Oscillator-amplitude
R189
R188
R186
No extension
Extended
Scale
J2
S5
S4
coarse
IF gain
Fine
R177
R176
Phones
(AF III)
C86
Bu/St3
D-c voltages to ground
are measured with
voltmeter of 1000 Ω / V



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